2002-2004: Effective Cr(III) recovery by gasification with heat production, Pittards PLC and Biomass Engineering Ltd., UK

50 kg/h leather wastes containerised gasifier coupled with gas cleaning system

Project objective

The combustion of leather wastes cause the Chrome(III) used in the tanning process to be converted to the toxic form Chrome (VI) and this has significant disposal costs associated with it. Gasification operates in a reducing atmosphere, therefore the Cr(III) should remain as Cr(III) after gasification. To this end, working with Biomass Engineering Ltd., the British Leather Corporation (BLC) and Pittards PLC, C.A.R.E. Ltd. worked on the retrofit of a existing gasification technology with a new gasifier with the objective of gasifying a range of leather wastes produced by Pittards with the primary aim of recovering Cr(III) from buffing dust and sludge cake in the residual ash from the process. The offgases would be water scrubbed to remove acid gases and other contaminants and then combusted for heat. C.A.R.E. Ltd. contributed to:

- Assessment of the process emissions,
- Evaluating process mass and energy balances,
- Evaluating the existing gas cleaning technology,
- Compliance with the Waste Incineration Directive (WID) and Integrated Pollution Prevention and Control (IPPC).

Project summary

The containerised gasifier was operated on Pittards site in Leeds, converting a range of leather wastes (buffing dust, wet blue and sludges). The unit was installed and commissioned on site in February 2004 after initial trials proved successful in late 2003 at Biomass Engineering Ltd.

Approximately 300 hours operation were obtained from February 2004 to May 2004. During this time the solids, liquids and gases were extensively analysed and characterised to assess the operability of the unit and environmental implications for larger units. Biomass Engineering Ltd. supplied training to Pittards staff to operate the unit and also provided support when required. Most of the work flared the process gases and only on a few occasions were the producer gases used for the drying of material for the briquettor. Analyses of the producer gases and char and ash are given in Table 1 and Table 2. The unit was typically operated for 6-8 hours, 3-5 days/week over the 3-month period, processing 40-50 kg/h of materials.

Observations made during the processing of the fuels were:

- Compared to wood gasification, fairly stable operation, in terms of constant gas output, was achieved; however, high ash materials were more prone to fluctuations in emissions and gas compositions.
- The gas heating value was particularly low when using sludge cake at 1.8 MJ/Nm^3 in some instances.
- The density of the sludge cake briquettes was a problem with densities over 800 kg/m^3, as the harder briquettes tended to form more tar, remain in their original shape and led to bridging problems in the gasifier (once every 20-30 minutes).
- Blends of sludge cake and buffing dust (3:1 dry mass ratio) were better than 100% sludge cake in terms of flow through the gasifier with fewer bridges.
- The moisture content of the briquetted material was 10wt% which is lower than the preferred range of 15-25wt%.
- The gas cleaning system needs to be significantly improved to allow for WID limits to be complied with.

Table 1. Average dry gas analysis (vol%) Feedstock wet blue

Gas	January 2004	July 2003 #
Carbon Monoxide [CO]	15.06	10.52
Hydrogen [H_2]	11.1	13.31
Methane [CH_4]	1.1	1.44
Carbon Dioxide [CO_2]	8.6	12.50
Ethylene [C_2H_4]	0.3	1.31
Ethane [C_2H_6]	0.01	0.16
Oxygen [O_2]	1.07	ND
Nitrogen + Argon [by difference]	58.65	60.49
HHV dry gas [MJ/Nm^3]	3.9	4.7
LHV dry gas [MJ/Nm^3]	3.7	4.3

Note: # work carried out by Biomass Eng. Ltd. at Newton-le-Willows

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Table 2. Analysis of the char/ash samples in May 2004 (wt%, as received)

Material	C	H	N	S	Cr	Ash
Fly ash from sludge cake	13.46	0.98	1.18	4.71	1.96	77.7
Sludge cake char/ash	7.22	0.05	0.25	4.35	2.84	85.3
Buffing dust char/ash	15.43	0.22	0.81	0.27	3.50	79.8

Project status

The testing of the leather wastes proved successful in recovering Cr(III) in the residual char and gas. An assessment of the gas cleaning costs to reduce contaminants to a manageable level for a gas engine showed that it would be uneconomic to do so. After the trials, no further work was carried out.